

(19) World Intellectual Property Organization
International Bureau



(43) International Publication Date
14 March 2002 (14.03.2002)

PCT

(10) International Publication Number
WO 02/21778 A1

(51) International Patent Classification⁷: **H04L 12/56**

(21) International Application Number: PCT/US01/26255

(22) International Filing Date: 22 August 2001 (22.08.2001)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
09/654,218 1 September 2000 (01.09.2000) US

(71) Applicant (for all designated States except US): **INTER-WAVE COMMUNICATIONS, INC.** [US/US]; 312 Constitution Drive, Menlo Park, CA 94025 (US).

(72) Inventor; and

(75) Inventor/Applicant (for US only): **FUTCHER, Edward,**

J. [US/US]; 25 Kenneth Road, Marblehead, MA 01945 (US).

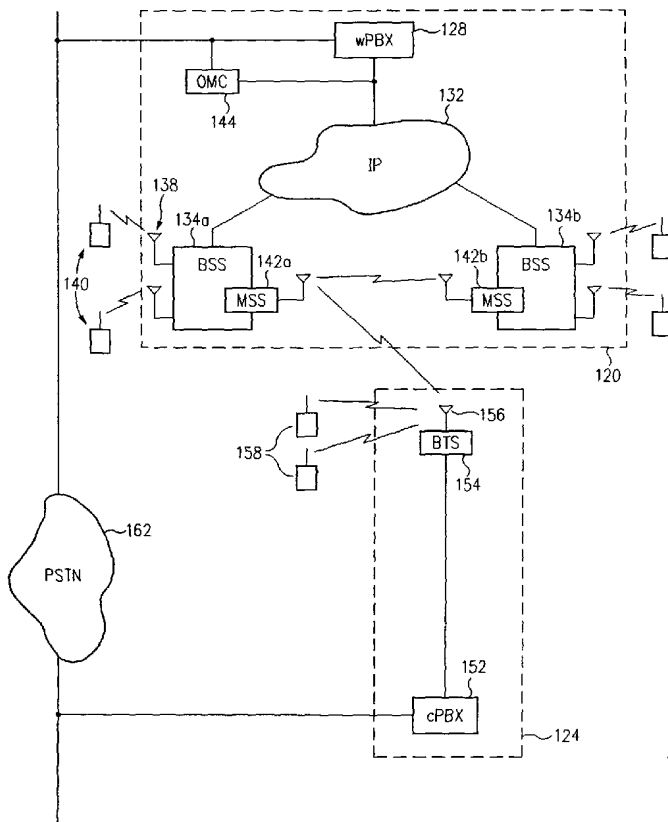
(74) Agents: **SWIATEK, Maria, S.** et al.; Flehr Hohbach Test Albritton & Herbert LLP, Suite 3400, 4 Embarcadero Center, San Francisco, CA 94111-4187 (US).

(81) Designated States (*national*): AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, BZ, CA, CH, CN, CO, CR, CU, CZ, DE, DK, DM, DZ, EC, EE, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, MZ, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, SL, TJ, TM, TR, TT, TZ, UA, UG, US, UZ, VN, YU, ZA, ZW.

(84) Designated States (*regional*): ARIPO patent (GH, GM, KE, LS, MW, MZ, SD, SL, SZ, TZ, UG, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE,

[Continued on next page]

(54) Title: ALTERNATE FAULT NOTIFICATION SYSTEM IN A COMMUNICATION NETWORK



(57) Abstract: The present invention provides for communication network with alternate network fault notification and a method for alternate fault notification. The communication network includes a first component (134a) coupled with a protocol network (132) and an alternate communication path such that the first component (134a) is configured to transmit information over at least the protocol network (132) and to receive information over both the protocol network and communication path. The communication network further includes a second component (134b) coupled with the protocol network and wirelessly coupled with the alternate communication path such that the second component (134b) transmits and receives information over the protocol network (132) and at least transmits a status signal over the alternate communication path.

WO 02/21778 A1



IT, LU, MC, NL, PT, SE, TR), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

— *before the expiration of the time limit for amending the claims and to be republished in the event of receipt of amendments*

Published:

— *with international search report*

For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

ALTERNATE FAULT NOTIFICATION SYSTEM IN A COMMUNICATION NETWORK

FIELD

5 The present invention relates generally to an alternate fault notification system. In particular, the invention provides a primary communication network with an alternate communication network to generate alternate fault notification when a fault on the primary communication network occurs.

BACKGROUND

10 Communication networks allow a plurality of devices to communicate between each other providing greater data transfers at increased speeds and at reduced costs. As the number of devices on a network increases, direct links between components becomes impractical and inefficient. The use of Internet Protocol (IP) networks enable
15 more efficient communication between components at a reduced cost with reduced overhead. Thus, the number of direct links between components has significantly reduced and will most likely continue to reduce.

 In communication networks utilizing direct links between components, the links are often an E1 or T1 link. If a direct link between two components fails, a fault
20 or failure is easily found because the fault can only be within the two devices directly coupled or within the direct link. However, with the increased use of IP networks, there no longer exists the direct link between components. Thus, when a fault occurs on a network it becomes increasingly difficult to determine the location of that fault. Further, since the IP network makes the communication between components so easy,

there is no limit on the distance between components. This further increases the difficulty in determining the location of faults.

To aid in the detection of faults on a communication network, components on the network are configured to monitor the communication paths between each other.

5 As such, a first component on the IP network will ping or send a status request signal to a second component on the IP network. When the second component receives the ping, it will send a return ping or status update to the first component. Thus, the components can continuously monitor the health of the communication between components.

10 If the first component does not receive a return ping, then the first component will signal an alarm or tell a central control component which will signal an alarm. However, because the IP network is not a direct connection there is no way of determining whether the second component is down and not responding, whether a portion of the IP network is down, or whether a router or other device on the IP
15 network is causing the problem. Thus, a technician must go out to the second component to determine if the component is malfunctioning. If the device is functioning correctly, then a technician must be sent out to check the IP network connections. If the IP network is functioning correctly, then a technician would have to be sent out to check the routers. This continues until the fault is found. Therefore,
20 there is a need to provide a communication network which utilizes a non-direct network for communication between components on the network with alternate fault notification capabilities.

Accordingly, a limitation of existing communication networks is that they are not equipped to generate information regarding devices which are still active when a
25 fault on the network has occurred nor are existing communication networks equipped to provide capabilities to diagnose the network and the components on the network.

What is needed is a communication network which utilizes an IP network that can provide status information regarding active components on the network when a fault occurs on the network. What is further needed is a communication network
30 which provides diagnostic capabilities to reduce the cost and time of locating faults on a network.

SUMMARY

The invention overcomes the identified problems and provides a primary communication network with an alternate communication network to generate status signals (e.g. pings) when a fault on the primary communication network occurs. The communication network includes a first component coupled to a protocol network and an alternate communication path such that the first component is configured to transmit information over at least the protocol network and to receive information over both the protocol network and the alternate communication path. The primary communication network further includes a second component coupled with the protocol network and wirelessly coupled with the alternate communication path such that the second component transmits and receives information over the protocol network and at least transmits the status signal over the alternate communication path. The second component is configured to transmit a ping over the protocol network to the first component and the first component is configured to receive the ping and to transmit a return ping over the protocol network to the second component. The second component is further configured to transmit the status signal to the first component over the alternate communication path if the return ping is not received from the first component.

In one embodiment, the alternate communication path includes a macro-cellular communication network to transmit the status signal to the first component.

In another embodiment, the alternate communication path includes a wireless local area network to transmit the status signal to the first component.

In another embodiment, the second component includes a mobile station subsystem to provide cellular communication to the alternate communication path.

In yet another embodiment the second component includes a wireless modem to provide wireless communication to the alternate communication path.

Advantages of the invention include the ability to provide an alternate path for notifying the communication network that a fault has occurred on the network and that the fault is not with the reporting component. This allows for a quicker determination of the fault location, reducing the repair time and cost needed to analyze the network and make the needed repairs.

BRIEF DESCRIPTION OF THE FIGURES

Additional advantages of the invention will become apparent upon reading the following detailed description and upon reference to the drawings, in which:

Figure 1 depicts a schematic diagram of one embodiment of the
5 communication network with alternate fault notification of the present invention including the alternate cellular communication network;

Figures 2A-B depict a schematic diagram of the modular base station subsystems;

Figure 3 depicts a schematic diagram of one embodiment of the
10 communication network where the secondary network of Figure 1 is coupled with the primary network through the internet protocol (IP) network;

Figure 4 depicts a schematic diagram of one embodiment of the communication network with alternate fault notification of the present invention including the alternate local area network communication network;

15 Figure 5 depicts a schematic diagram of one embodiment of the communication network where the secondary network of Figure 4 is coupled with the primary network through the internet protocol (IP) network;

Figure 6 depicts a schematic diagram of one embodiment of the communication network with alternate fault notification including a plurality of
20 wireless public branch exchanges and base station subsystems, and alternate cellular communication network; and

Figure 7 shows a flow diagram of a method for performing the alternate fault notification of the present invention.

25 DETAILED DESCRIPTION

Exemplary embodiments are described with reference to specific configurations. Those skilled in the art will appreciate that various changes and modifications can be made to the exemplary embodiments while remaining within the scope of the claims. For example, the exemplary embodiments are described with
30 reference to the Global Systems for Mobile Communications (GSM) protocol. However, any communication protocol and a wide range of frequencies can be used in the invention.

In one embodiment, the present invention provides a primary communication network with the capability to provide fault notification through secondary alternate communication paths and networks, as well as through alternate paths of the primary communication network. The primary communication network further provides the
5 capability to perform remote diagnostics of the primary network.

In one embodiment, the primary communication network of the present invention provides communication between the components of the network through a protocol network, during normal operating conditions. The protocol network is any conventional network providing communication including an internet protocol (IP)
10 network, an asynchronous transfer mode (ATM) network, and any other conventional packetized network. The present invention further utilizes the alternate secondary communication network to provide an alternate communication path for diagnostic and fault notification. The secondary communication networks utilized in the invention for an alternate communication paths include, but are not limited to, macro-
15 wireless communication networks such as public cellular communication networks, private cellular communication networks, wireless communication networks (commonly referred to as cordless communication), and wireless local area networks (LAN).

FIG. 1 depicts one embodiment of the invention where a primary network 120
20 couples with a secondary network 124 to provide the primary network with an alternate path for status signal updates or fault notification. In one embodiment, the primary network 120 is a private wireless communication network or system coupled with the secondary network 124 which, in one embodiment, is implemented through a macro-cellular communication network as the alternative communication path for fault
25 notification. In one embodiment, cellular communication network 124 utilizes a Global Systems for Mobile Communications (GSM) protocol, however, any convenient wireless or cellular protocol can be employed as is known in the art. Primary network or wireless communication network 120 includes a wireless private branch exchange (wPBX) 128 coupled to an IP network 132 which provides a
30 communication path for wPBX 128 to at least one, usually a plurality of network components, including a plurality of base station subsystems (BSS) 134a-b and other components of network 120 coupled to IP network 132. In one embodiment, each BSS 134a-b includes antennas 138 to facilitate wireless communication with a

plurality of mobile handsets or mobile stations (MS) 140. MS's 140 are any conventional device having cellular communication capabilities including, cellular telephones, computers with cellular data transmission capabilities, and any other device with wireless communication capabilities known in the art. BSS's 134a-b
5 further include an alternative wireless communication module or wireless transmitter for communicating with wPBX 128. In one embodiment, the alternative communication module includes a mobile station subsystem (MSS) 142 which provides BSS 134 with cellular communication capabilities. Wireless communication network 120 further includes a controller or operation and maintenance center (OMC)
10 144 coupled to wPBX 128 and IP network 132 to provide network control and network monitoring. In one embodiment, wPBX and OMC 144 are combined as a single controller. OMC 144 includes an interface to provide information to a technician monitoring primary network 120, and to receive control information or commands from the technician. The interface allows the technician to control primary
15 network 120, receive alarm status information from OMC 144 if problems occur on primary network 120, and run diagnostic tests on the system.

BSS's 134a-b are designed to be modular such that they are configured in any conventional manner to provide wireless communication to MS 140 as is known in the art. FIG. 2A depicts one embodiment of modular BSS 134 which includes a base
20 station controller (BSC) 146, base station transceiver (BTS) 148, trunk module 150 (for IP interface, LAN interface and such), antennas 138 and MSS 142. FIG. 2B depicts one embodiment of BSS 134 which is positioned separate and away from a base station controller, thus BSS 134 includes BTS 148, trunk module 150, antennas 138 and MSS 142. A detailed description of BSC 146, BTS 148 and trunk module
25 150 is found in U.S. Patent Nos. 5,734,699 and 5,577,029 and U.S. Application Serial No. 08/914,982, incorporated herein by reference.

In one embodiment wPBX 128 is configured to provide call, information and data transfer control for the wireless communication network 120, including call routing, call handovers between BSSs and other components on the wireless network
30 120. Because information or calls are routed to network components through IP network 132 as opposed to direct links, such as E1 or T1 lines, wPBX 128 is further designed to provide verification that the components on the primary network 120 are operating properly, and receiving control signals and information over IP network 132.

As is known in the art and described above, one method for verification is performed through a periodic or scheduled request for a status response and a reply response, commonly referred to as pinging. In one example, a first component, for example wPBX 128, will periodically ping or send a status update signal to a second
5 component on the network 120, for example BSS 134a. BSS 134a will then send a return ping or response signal to wPBX 128. Thus, verifying that the communication paths between components are active and that the BSS 134a is operating. In an alternative embodiment, a component on the network 120, for example BSS 134a, will send out the initial ping to a second component, for example wPBX 128, and wPBX
10 128 will reply with the return ping to verify the communication path. In one embodiment, wPBX 128 and/or OMC 144 submits a diagnostic request to BSS 134a-b or other components of the primary network 120. The BSS's 134a-b will perform the requested diagnostics and transmit the results of the diagnostics back to wPBX 128 and OMC 144.

15 In one embodiment, if the BSS 134a does not receive a status update signal or ping from the wPBX 128 for a predefined period of time, BSS 134a will shift to an alternate fault notification mode. In the alternate fault notification mode, BSS 134a assumes there is a fault in the IP network communication path or with wPBX 128. BSS 134a then attempts to contact wPBX 128 and OMC 144 through an alternate
20 communication path. One alternate path is by communicating wirelessly with another component on the network 120, for example the second BSS 134b. The first BSS 134a will wirelessly signal the second BSS 134b to forward a status signal from the first BSS 134a to the wPBX 128 and OMC 144. In one embodiment, if communication is achieved between second BSS 134b and wPBX 128 and/or OMC
25 144, second BSS 134b will signal first BSS 134a via the wireless communication provided by MSS's 142a-b. In one embodiment, an alternative communication path is through the secondary network or alternate communication path allowing first BSS 134a to notify wPBX 128 and OMC 144 that BSS 134a is still operating and not the cause of the network fault or error. Further, the alternative communication paths can be
30 utilized to transmit diagnostic requests to components of the primary network 120 such as BSS 134a and to transmit diagnostic results back from the components to the wPBX 128 and OMC 144.

In the alternate notification mode, BSS 134a will utilize at least one of the alternate communication paths, second BSS 134b and/or secondary or alternate fault notification network 124, to notify OMC 144 and wPBX 128 that BSS 134a is active and operating. Thus, eliminating the need to send a technician out into the field to test BSS 134a. The network operator or technician will receive the status signal or fault message from BSS 134a and know that the fault or problem with the network 120 is not with BSS 134a, reducing the cost and time of analyzing the network to determine the fault location.

Still referring to FIG. 1, when a fault is detected MSS 142a provides BSS 134a with alternate cellular communication capabilities through second BSS 134b and alternate cellular communication network 124. MSS 142a is implemented through any conventional manner which provides cellular communication including utilizing a mobile station circuit design or other cellular communication techniques known in the art. In one embodiment secondary network 124 is a macro-cellular network such that MSS 142a has subscribed to macro-cellular network 124. Secondary network 124 operates by providing cellular communication coverage over the physical area where BSS 134 is located. In one embodiment secondary network 124 includes at least one cellular PBX (cPBX) 152 to control secondary network 124 and route calls to MS's 158 operating within the coverage area. In one embodiment, secondary network is a public network a public mobile station controller (MSC) and/or base station controller (BSC). Secondary network 124 further includes at least one wireless receiver. In one embodiment, the wireless receiver is a base transceiver station (BTS) 154 which includes antennas 156 to provide communication to MS's 158 which are within BTS 154 coverage. BTS 154 further provides wireless communication for MSS 142a for alternate fault notification.

When utilizing the secondary network 124 and a fault is detected, the first BSS 134a shifts to alternate fault notification mode, MSS 142a is active and sends a fault notification signal, message or status signal to BTS 154 of the secondary communication network 124. BTS 154 forwards the fault notification signal to cPBX 152 which in turn forwards the fault notification signal to wPBX 128 and OMC 144. Coupling between primary network 120 and secondary network 124 is achieved through any convenient manner including E1 or T1 direct link, an IP network, a public switching telephone network and any other manner known in the art. Still referring to

FIG. 1, cPBX 152 couples with primary network 120 including wPBX 128 and OMC 144 through a public switching telephone network (PSTN) 162. PSTN 162 routes the fault notification signal from cPBX 152 to OMC 144 and wPBX 128. Thus, OMC 144 and wPBX 128 receive the alternate fault notification signal from BSS 134a to
5 verify that BSS 134a is active and operating. OMC 144 notifies the technician that the fault in the primary network 120 is not BSS 134a but instead some other component, such as a fault in the communication path of IP network 132.

In one embodiment, secondary network 124 provides short message service (SMS) capabilities. This allows MSS 142 to communicate over secondary network
10 124 by transmitting status and diagnostic information utilizing the SMS capabilities of cellular network 124.

In one embodiment, the secondary network 124 is a sub-network of the primary network 120. Thus, the fault notification issued by BSS 134a is forwarded through the primary network 120 to the wPBX 128 and OMC 144 utilizing the sub-
15 network 124.

FIG. 3 shows an alternate embodiment of the invention where the primary network 120 is coupled with the secondary communication network 124 through the IP network 132. Thus, the IP network provides the communication path between the secondary network 124 and the primary network 120 for fault notification.

20 In another embodiment, the alternate communication path for fault notification between BSS 134 and OMC 144 is achieved through a wireless modem which transmits information to a local area network (LAN). Referring to FIG. 4, primary communication network 120 includes: wPBX 128 to provide control for network 120 and call routing; OMC 144 to monitor network 120, output network status information
25 and receive network control instructions; IP network 132 to provide communication between components of communication network 120; and BSS 134 to provide wireless communication for MS's 140 and alternate fault notification. As described above, proper network operations are monitored through pinging or sending status signals between components. When a fault is detected in primary network 120, for
30 example BSS 134 does not receive a ping from wPBX 128 or OMC 144 for a predefined period, BSS 134 utilizes the wireless transmitter to provide the alternative fault notification to OMC 144 and wPBX 138. This informs OMC 144 and wPBX 128 that BSS 134 is still operating and is not the source of the network failure.

In the embodiment shown in FIG. 4, the wireless transmitter of BSS 134 is a wireless modem 170. Wireless modem 170 provides wireless communication to the secondary network or alternate communication network 124. Secondary network 124 includes a wireless receiver, wireless access point or wireless LAN base station (LAN BS) 172 which includes antenna 174 to allow communication between LAN BS 172 and wireless modem 170. LAN BS 172 couples with a processor or central process 178 which provides control to the LAN system and the transmission of information to and from LAN BS 172. Processor 178 further couples with a wired transmission line 182 which provides wired communication between processor 178 and other components on an overall network, including primary network 120. wPBX 128 and OMC 144 couple to transmission line 182 to receive information from and to transmit information to processor 178. Transmission line 182 is implemented through any convenient manner including an E1 line, T1 line, a network such as a PSTN, IP or LAN network, or any other manner known in the art.

When a fault on the network is detected, wireless modem 170 is active and transmits a fault message or fault notification signal to LAN BS 172. LAN BS 172 forwards the fault notification to processor 178 which forwards the fault notification to wPBX 128 and OMC 144 over transmission line 182. In one embodiment wireless modem 170 communicates over LAN to OMC 144 by transmitting an e-mail message as is known in the art. Thus, wireless communication network 120 provides a technician with notification that a fault has occurred on the network 120 and the fault is not within BSS 134. Therefore, the cost and time of correcting the fault is reduced.

FIG. 5 shows an alternate embodiment of the invention where the wireless communication network or primary network 120 is coupled with the secondary or alternate communication network 124 through IP network 132.

The individual network components of the present invention can further be configured to perform self diagnostics or diagnostics of the overall network. For example, in one embodiment, the BSS 134 includes the capability to perform diagnostic analysis on the internal components of BSS 134 and report the results of the diagnostics to OMC 144 and wPBX 128 over IP network 132 or through the alternate communication paths, including the second BSS 134b and secondary network 124. In one embodiment, MSS 142 and wireless modem 170 further include the capability to receive commands from OMC 144 through the alternate communication paths (second

BSS 134b and secondary network 124) or IP network 132, to instruct BSS 134 to initiate specific diagnostics of BSS 134 and report the results back to OMC 144. In one embodiment, if BSS 134 experiences functional errors or fatal errors, BSS 134 is configured to transmits error codes and fatal error messages over the IP network 130
5 or through the alternate communication paths of second BSS 134b or secondary network 124, prior to going inactive or offline. This provides the technician with further information about the errors experienced by BSS 134. In one embodiment, MSS 142 is configured to receive control signals from OMC 144 directing BSS 134 to send status update request signals to other components on wireless communication
10 network 120 and report responses from those other components back to OMC 144 through the IP network 132 and alternate communication paths . This provides the technician with the capability to perform network diagnostics to further analyze network faults and pinpoint the location of network faults.

In one embodiment of the invention, other components of the wireless network
15 120 are configured to include alternate fault notification capabilities. The other components include any conventional component on a communication network including bridges, modems, switches (including optical and other switches), routers, amplifiers, and any other communication component known in the art. Thus, when network faults occur, the technician will receive signals from the components on the
20 network which are still active thus pinpointing the fault and significantly reducing the time and cost to correcting the fault.

FIG. 6 depicts an embodiment of a primary network 120 of the invention which includes a plurality of wPBX's 128a-b, each positioned a distance from the other and each coupled to IP network 132. Each wPBX 128 communicates with the
25 other wPBX's over IP network 132 to provide greater control of the overall network. Each wPBX 128 provides call routing and network control to a plurality of BSS's 134a-d. The primary network 120 further includes a plurality of OMC's 144a-b to provide network control and alarm reporting. Each BSS 134 provides communication to a plurality of MS's 140a-d. Each wPBX 128a-b and each BSS 134a-d include
30 alternate fault notification capabilities. In one embodiment, each wPBX 128a-b and each BSS 134a-d include an alternate fault notification module such as an MSS 142 which provides wireless communication to a secondary network 124. Secondary network 124 includes a cPBX 152 and a plurality of BTS's 154a-b which provide

communication from MSS's 142 to cPBX 152. cPBX 152 couples with PSTN 162 which routes the fault notification signals from MSS's to OMC's 144 and wPBX's 128a-b.

5 The communication between the BTS's 154 and MSS's 142 of the invention are implemented through any conventional manner which provides wireless communication including cellular mobile station circuitry, wireless modem, optics, BlueTooth technology and other wireless communication techniques known in the art.

The invention is designed to operate within building or campus networks in parallel or in conjunction with a macro-cellular network, LAN network or other
10 alternate wireless communication networks. The invention is further designed to work with networks which include satellite offices such that the network utilizes an IP network communication path to provide communication over large distances. Thus, making alternate fault notification even more beneficial because a technician does not have to go all the way to the satellite location to test the components of the network
15 which are still operating.

FIG. 7 shows a flow chart of one embodiment of the method of performing fault notification through a secondary or alternate communication network. Initially, in step 220, a fault in the primary network 120, for example a cellular communication network, is detected by a network component, such as a BSS 134. In step 222, BSS
20 134 activates the alternate fault notification module and wirelessly transmits a fault message to the secondary network 124, for example a macro-cellular network. In step 226, secondary network 124 receives the fault message through a wireless receiver, such as a BTS 154. In step 228, BTS 154 communicates the fault notification to a secondary network controller, for example a cPBX 152. The communication between
25 the primary network 120 and the secondary network 124 is achieved through any convenient manner including through a PSTN 162, through IP network 132 and other communication techniques known in the art. In step 232, cPBX 152 communicates the fault message to the primary network controller, for example a wPBX 128 and OMC 144. Primary network controller then notifies the network technician that a fault
30 has occurred on the network and the BSS 134 is not the cause of the fault, in the final step 236.

Advantages of the invention include the ability to provide notification to technicians when a fault on the communication network occurs, which devices are still

active and thus not the cause of the network fault significantly reducing the cost, and time needed to repair faults on the network. Further, the invention provides the ability to remotely perform network diagnostics without going to the remote locations, again, reducing the cost and time needed to repair faults on a network.

- 5 Having disclosed exemplary embodiments and the best mode, modifications and variations may be made to the disclosed embodiments while remaining within the scope of the invention as defined by the following claims.

WHAT IS CLAIMED IS:

1. A communication network having alternate fault notification capabilities, comprising:
 - 5 a primary network having at least one primary network component
the at least one primary network component having a wireless transmitter configured to transmit a fault message; and
a secondary communication path, coupled with the primary network, having at least one wireless receiver configured to receive the fault message and communicate
10 the fault message to the primary network.
2. The communication network as claimed in claim 1, wherein:
the primary network includes at least one controller configured to receive a ping from the primary network component.
15
3. The communication network as claimed in claim 1, wherein:
the primary network includes at least one controller configured to ping the primary network component.
- 20 4. The communication network as claimed in claim 3, wherein:
the primary network includes at least one controller configured to receive a ping from the primary network component.
5. The communication network as claimed in claim 3, wherein:
25 the primary network component is further configured to transmits the fault message to the controller over the secondary communication path if the ping is not received from the controller for a predefined period of time.
6. The communication network as claimed in claim 4, wherein:
30 the primary network component is further configured to transmits the fault message to the controller over the secondary communication path if a return ping is not received from the controller.

7. The communication network as claimed in claim 1, wherein:
the secondary communication path is coupled with the primary network
through an internet protocol (IP) network.
- 5 8. The communication network as claimed in claim 1, wherein:
the secondary communication path is coupled with the primary network
through an public switching telephone network.
9. The communication network as claimed in claim 1, wherein:
10 the secondary communication path is a cellular communication network.
10. The communication network as claimed in claim 1, wherein:
the secondary communication path is a local area network (LAN).
- 15 11. A communication network having alternate fault notification capabilities,
comprising:
a first component coupled with a protocol network and coupled with an
alternate communication path such that the first component is configured to transmit
information over at least the protocol network and to receive information over both the
20 protocol network and the alternate communication path; and
a second component coupled with the protocol network and wirelessly coupled
with the alternate communication path such that the second component is configured
to transmit and receive information over the protocol network and to at least transmit
a status signal over the alternate communication path to the first component.
- 25 12. The communication network as claimed in claim 11, wherein:
the alternate communication path is an alternate communication network
coupled with the primary network and configured to at least communicate information
to the first component.
- 30 13. The communication network as claimed in claim 12, wherein:
the second component is configured to transmit a ping over the protocol
network to the first component;

the first component is configured to receive the ping and to transmit a return ping over the protocol network to the second component; and

the second component is further configured to transmit the status signal to the first component over the alternate communication network if the return ping is not
5 received from the first component.

14. The communication network as claimed in claim 12, wherein:

the first component is configured to periodically transmit a ping over the protocol network to the second component;

10 the second component is configured to receive the ping and to transmit a return ping over the protocol network to the first component; and

the second component is further configured to transmit the status signal to the first component over the alternate communication network if the ping is not received from the first component for a predefined period of time.

15

15. The communication network as claimed in claim 14, wherein:

the alternate communication network is a cellular communication network configured to at least wirelessly receive the status signal .

20 16. The communication network as claimed in claim 15, wherein:

the cellular communication network includes a public switching telephone network (PSTN) such that the first component couples with the PSTN; and

the cellular communication network transmits the status signal to the first component over the PSTN.

25

17. The communication network as claimed in claim 15, wherein:

the cellular communication network including short message service capabilities; and

the status signal is sent over the cellular communication network using the
30 short message service.

18. The communication network as claimed in claim 14, wherein:
the alternate communication network is a wireless local area network (LAN)
configured to provide wireless communication.
- 5 19. The communication network as claimed in claim 14, wherein:
the LAN including e-mail capabilities; and
the status signal is sent over LAN using the e-mail capabilities.
20. The communication network as claimed in claim 14, wherein:
10 the second component includes a wireless communication module configured
to provide the wireless communication to the alternate communication network.
21. The communication network as claimed in claim 20, wherein:
the wireless communication module is a mobile station subsystem configured
15 to provide cellular communication to the alternate communication network.
22. The communication network as claimed in claim 20, wherein:
the wireless communication module is a wireless modem configured to provide
wireless communication to the alternate communication network.
20
23. The communication network as claimed in claim 14, wherein:
the first component is a wireless public branch exchange (WPBX).
24. The communication network as claimed in claim 23, wherein:
25 the second component is a base station subsystem (BSS).
25. The communication network as claimed in claim 11, wherein:
the second component is further wirelessly coupled with the alternate
communication path such that the second component is configured to wirelessly
30 transmit the status signal over the alternate communication path.

26. The communication network as claimed in claim 11, wherein:
the second component configured to wirelessly received commands from the
first component transmitted over the alternate communication path.
- 5 27. The communication network as claimed in claim 26, wherein:
the second component configured to wirelessly received commands from the
first component transmitted over the alternate communication path and to perform
diagnostic analysis on modules of the second component.
- 10 28. The communication network as claimed in claim 11, wherein:
the second component configured to:
wirelessly received commands from the first component transmitted
over the alternate communication network;
transmit status request signals to a third component coupled to the
15 protocol network;
receive a return status signal from the third component; and
wirelessly transmit the return status signal from the third component to
the first component over the alternate communication network.
- 20 29. A method for providing alternate fault notification in a communication
network, comprising:
determining a fault has occurred in a primary network;
wirelessly transmitting a fault message to an alternate communication path;
25 receiving the fault message on the alternate communication path; and
communicating the fault message over the alternate communication path to a
first primary network component of the primary network.
30. The method for providing alternate fault notification as claimed in claim 29,
30 wherein:
the step of wirelessly transmitting the fault message including wirelessly
transmitting the fault message by cellular communication to the alternate
communication path.

31. The method for providing alternate fault notification as claimed in claim 30, wherein:

the step of communicating the fault message over the alternate communication path to the first primary network component including wirelessly transmitting a short message service signal to the alternate communication path and communicating the short message service signal over the alternate communication path to the first primary network component.

32. The method for providing alternate fault notification as claimed in claim 29, wherein:

the step of wirelessly transmitting the fault message including wirelessly transmitting the fault message by a wireless modem to the alternate communication path.

33. The method for providing alternate fault notification as claimed in claim 32, wherein:

the step of wireless transmitting the fault message by a wireless modem such that the alternate communication path is a local area network (LAN).

34. The method for providing alternate fault notification as claimed in claim 33, wherein:

the step of communicating the fault message over the alternate communication path to the first primary network component including wirelessly transmitting an e-mail message over the secondary network to the primary network controller.

25

35. A method of providing network diagnostics, comprising the steps of:

wirelessly transmitting a status signal to a secondary communication path when a primary communication network is failing;

communicating the status signal over the secondary communication path to a first primary network component coupled with both the primary communication network and the secondary communication path.

36. The method as claimed in claim 35, further comprising the steps of:
initiating the transmitting of the status signal when a ping is not received after
a predefined period of time.
- 5 37. The method as claimed in claim 35, further comprising the steps of:
initiating the transmitting of the status signal following a status signal request.
38. The method as claimed in claim 35, further comprising the steps of:
determining a failure has occurred on the primary communication network
10 prior to the step of transmitting the status signal.
39. The method as claimed in claim 38, wherein:
the step of determining including not receiving a ping at a second primary
network component from the first primary network component for a predefined period
15 of time.
40. The method as claimed in claim 35, further comprising the steps of:
signaling from the first primary network component to a second primary
network component to request status updates from a third primary network
20 component; and
transmitting the requested status update from the second primary network
component to a third primary network component; and
signaling from the second primary network component to the first primary
network component an update from the third primary network component.
25
41. The method as claimed in claim 40, wherein:
the step of transmitting the requested status update including wirelessly
transmitting the status update from the second primary network component to the third
primary network component.
30
42. The method as claimed in claim 41, further comprising the steps of:
receiving the update from the third primary network component prior to the
step of signaling from the second network component.

1/7

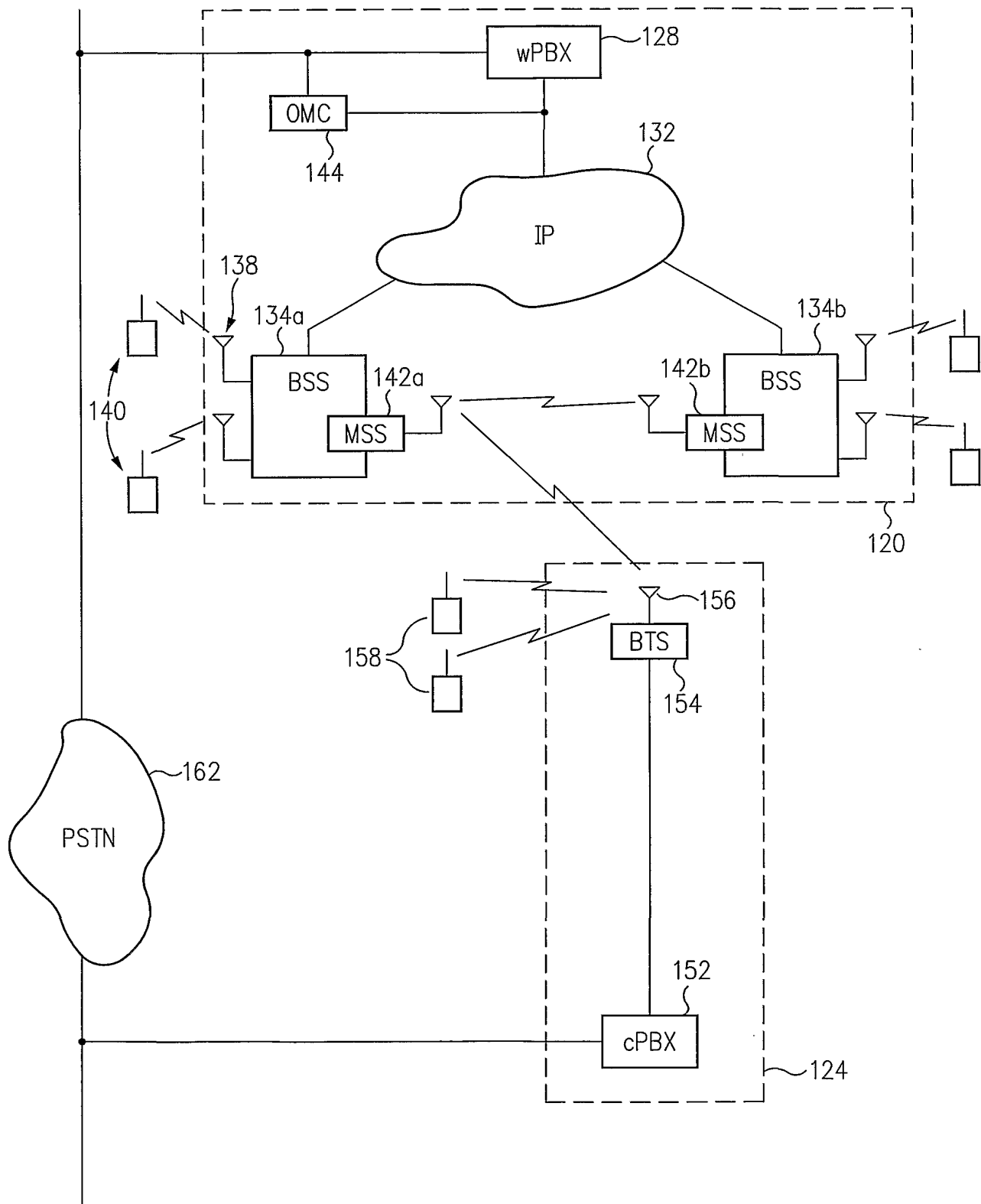


FIG. 1

2/7

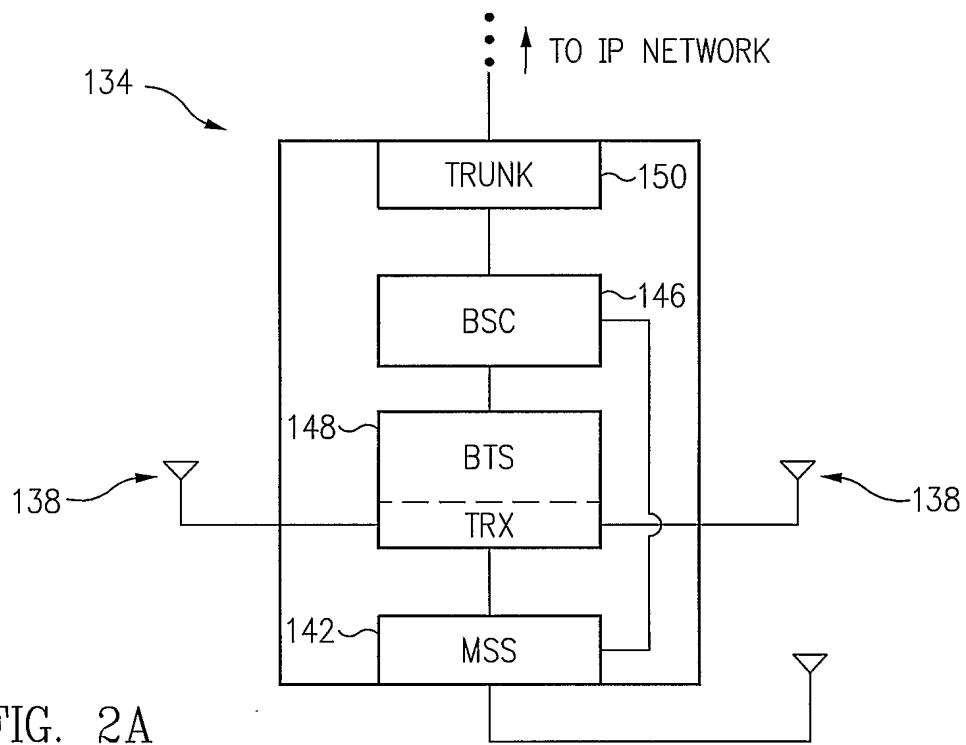


FIG. 2A

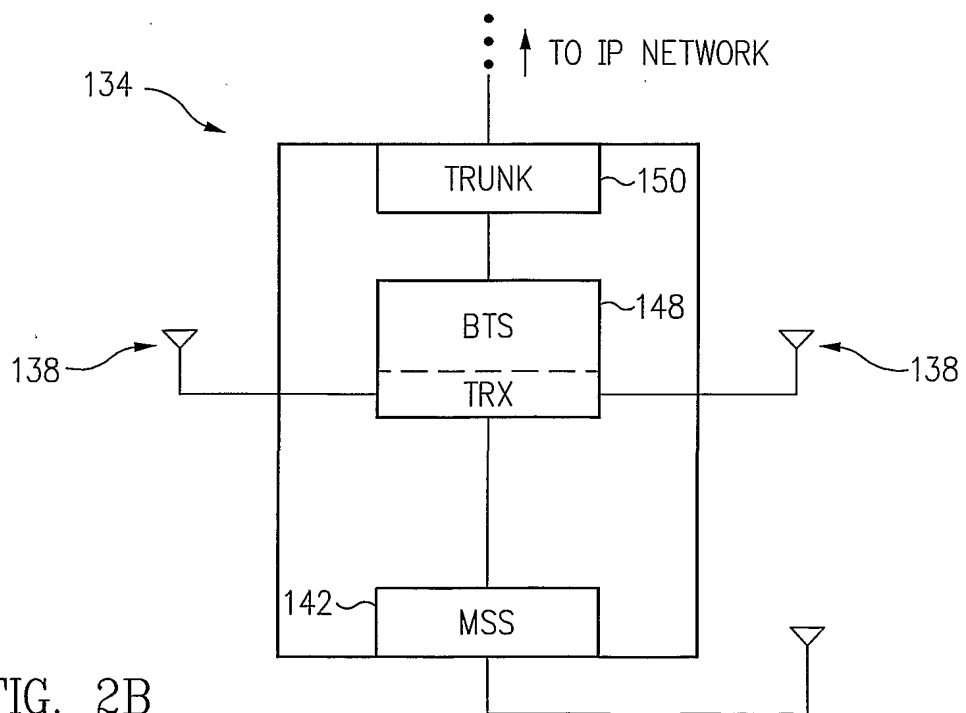


FIG. 2B

3/7

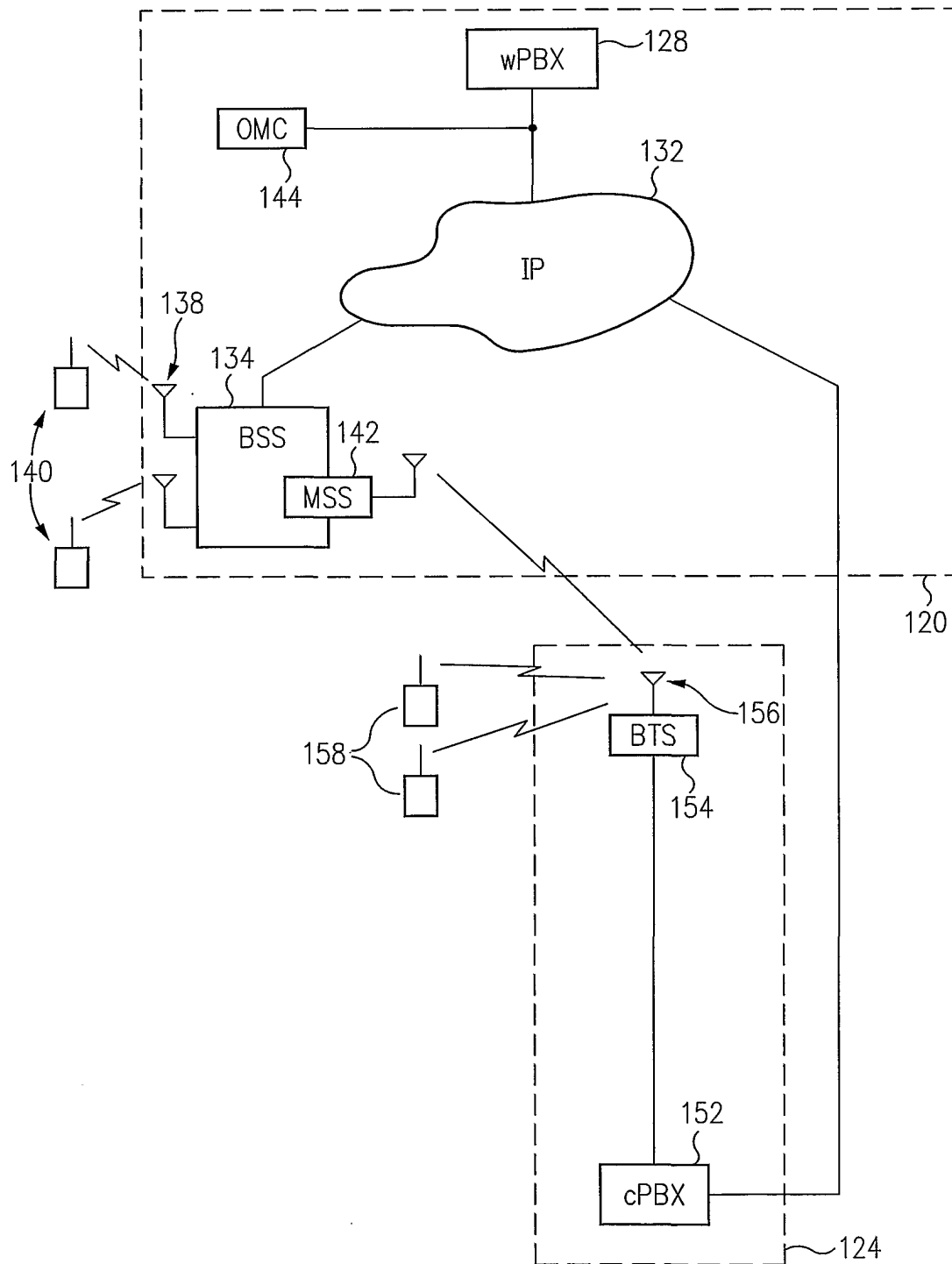


FIG. 3

4/7

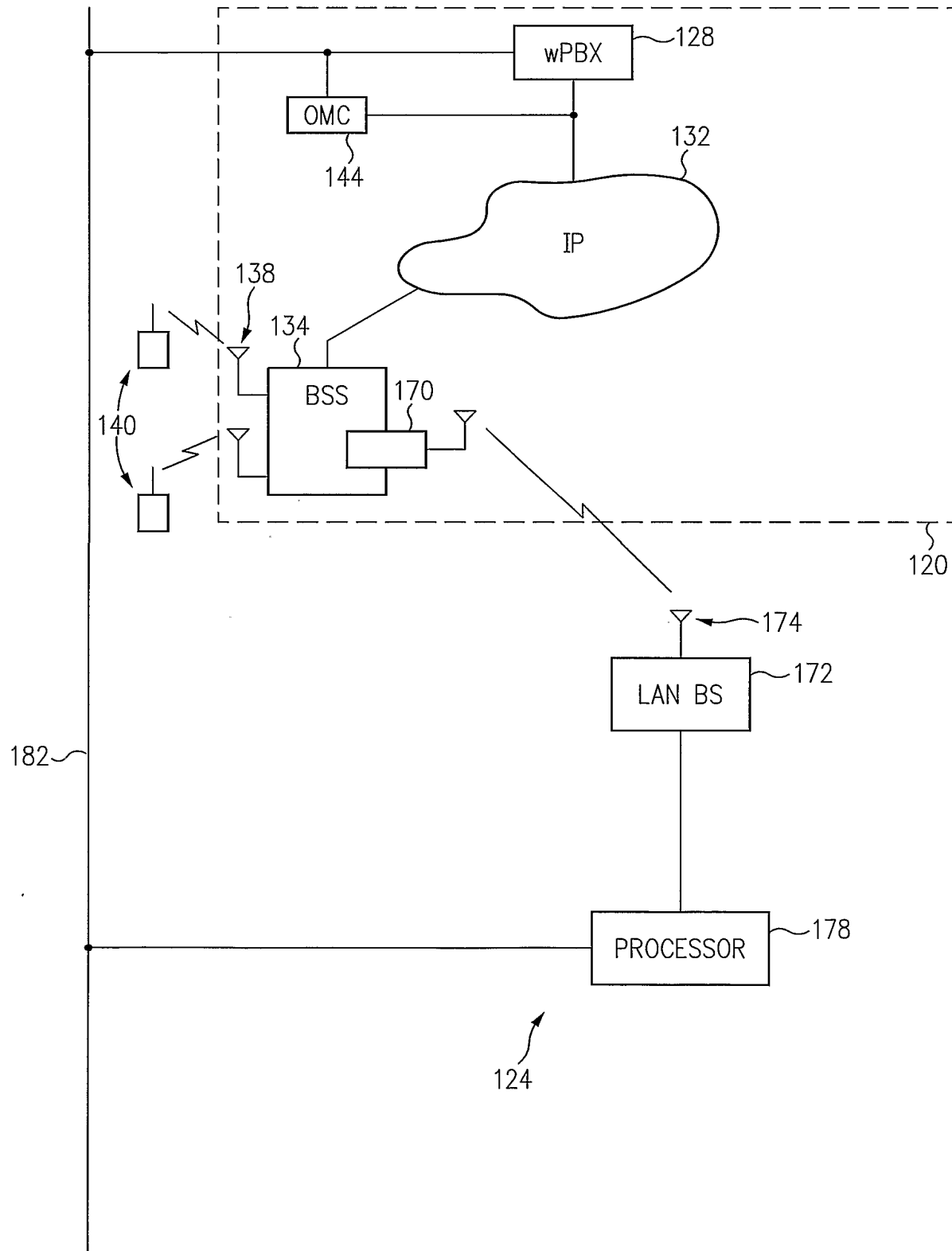


FIG. 4

5/7

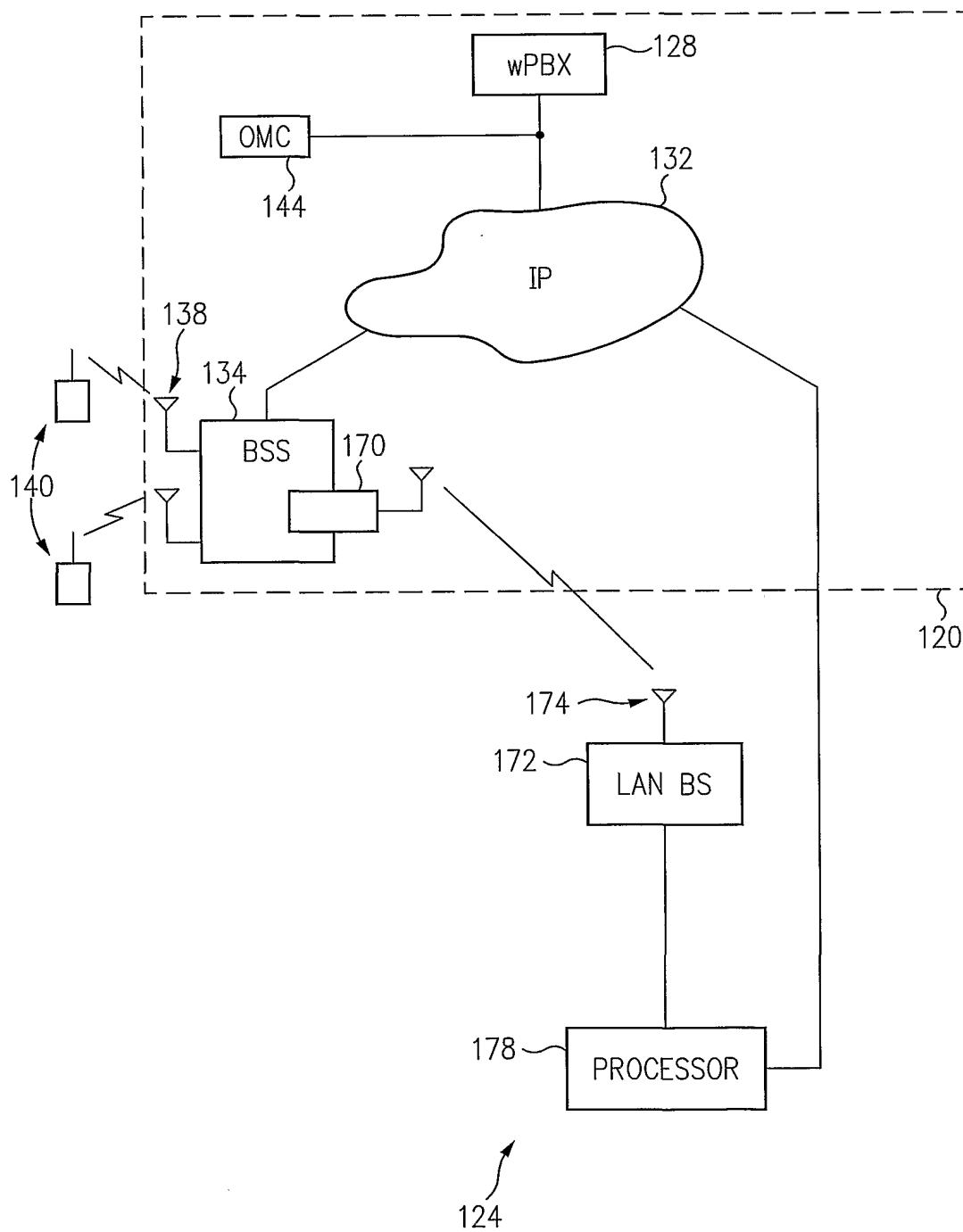


FIG. 5

6/7

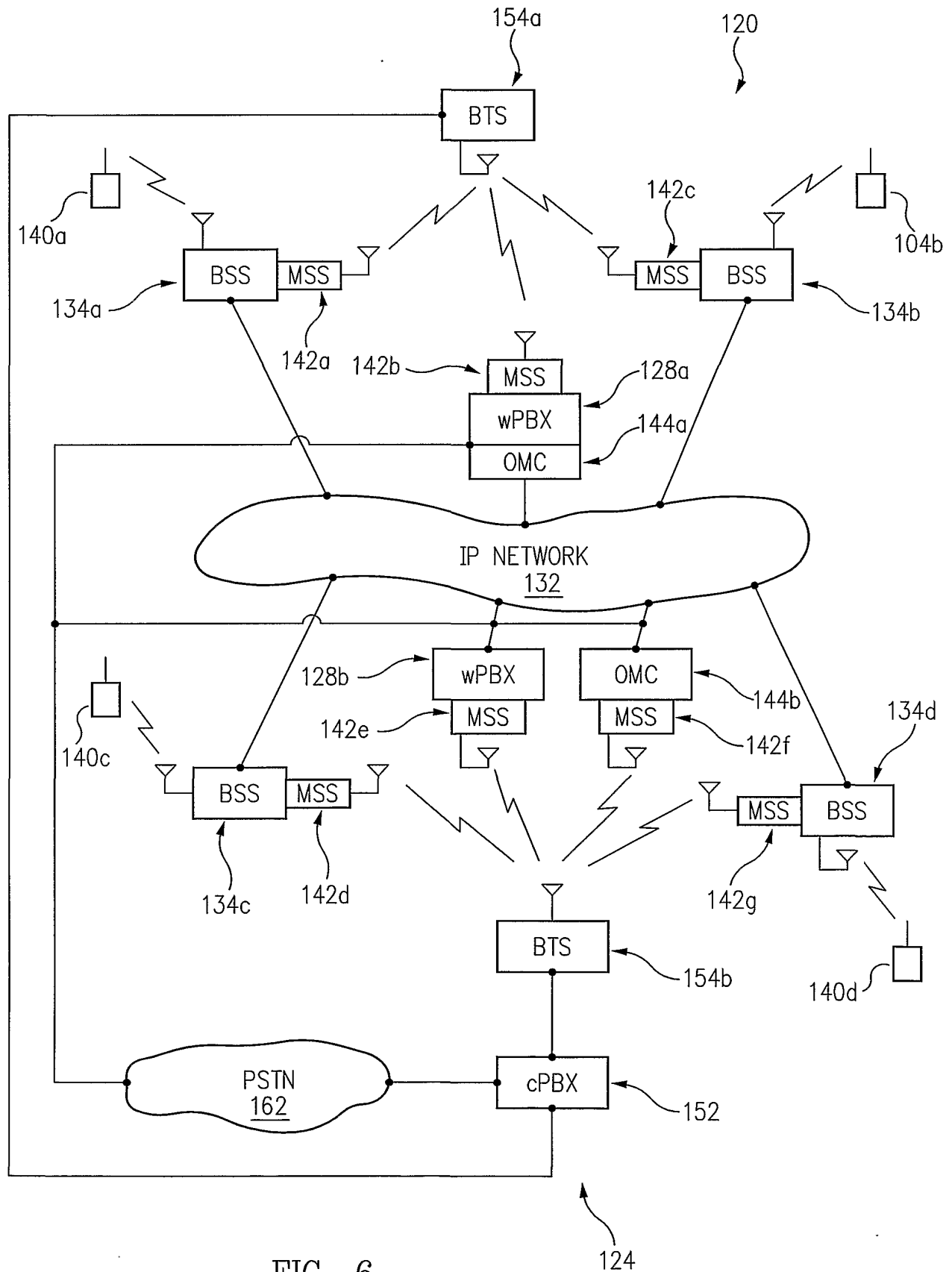


FIG. 6

7/7

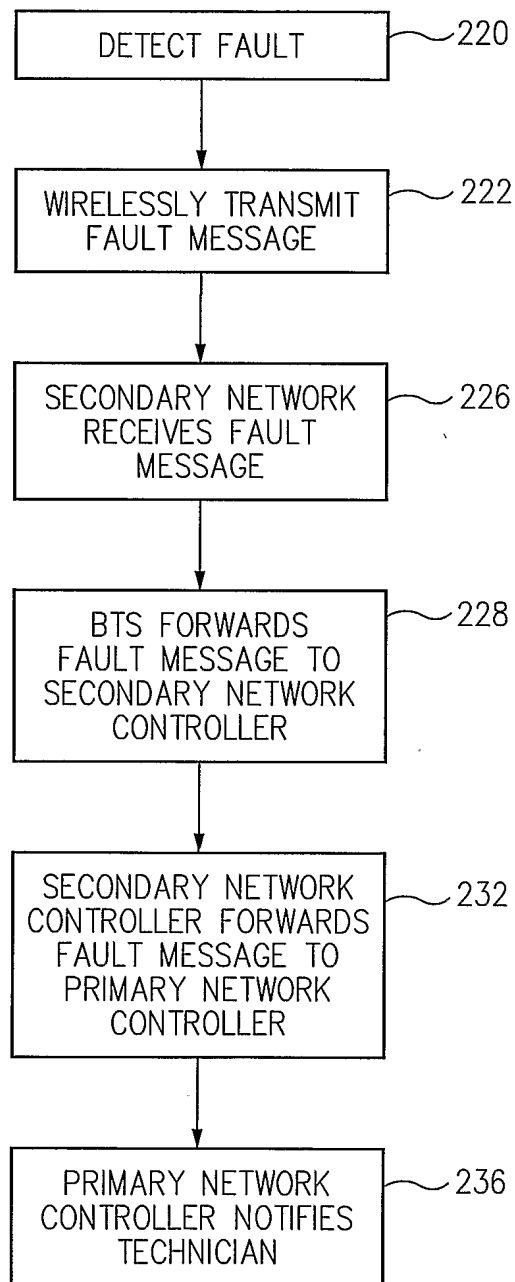


FIG. 7

INTERNATIONAL SEARCH REPORT

International application No.

PCT/US01/26255

A. CLASSIFICATION OF SUBJECT MATTER

IPC(7) : H04L 12/56

US CL : 370/216

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

U.S. : 370/242

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 5,862,201 A (SANDS) 19 JANUARY, 1999, ALL	1-42
A	US 5,878,326 A (BENZ ET AL) 02 MARCH, 1999, ALL	1-42

☐ Further documents are listed in the continuation of Box C.
 ☐ See patent family annex.

* Special categories of cited documents:	"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"A" document defining the general state of the art which is not considered to be of particular relevance	"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"E" earlier document published on or after the international filing date	"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)	"&" document member of the same patent family
"O" document referring to an oral disclosure, use, exhibition or other means	
"P" document published prior to the international filing date but later than the priority date claimed	

Date of the actual completion of the international search

22 OCTOBER 2001

Date of mailing of the international search report

28 JAN 2002

 Name and mailing address of the ISA/US
 Commissioner of Patents and Trademarks
 Box PCT
 Washington, D.C. 20231

Facsimile No. (703) 305-3230

Authorized officer

DOUG OLMS

Telephone No. (703) 305-4703